WEIGHING THE HEART AGAINST THE FEATHER OF TRUTH

WILLIAM B. OBER, M.D.

Department of Laboratories
Hackensack Hospital
Hackensack, New Jersey

MOST physicians accept with complacent pride the descent of the medical profession from Apollo's son Aesculapius and the high priests of his cult. With less complacency we trace our lineage to the medicine men and shamans of primitive tribes, but the relation between magical spells and rites and the evolution of modern medical practices cannot be gainsaid. One specialty in particular, pathology, can trace its roots to the Roman *haruspex,* who prophesied future events by examining the entrails of sacrificed animals. Indeed, much of the discipline of today's experimental pathology consists of precisely that. Archeological retrieval of clay and metal representations of the liver in Babylonian and Etruscan remains (Figure 1) testifies to the remote origin of the *haruspices* and to the principal organ upon which their divinations focused, but the Romans never accorded them official status. There was no Royal College of Haruspices. For official divination the Romans relied on the guidance of *auspices,* who drew their inferences from the flight of birds and such melodramatic effects as flashes of lightning and crashes of thunder. The rules of practice for *auspices* were well codified and their nomenclature well standardized. But one contribution of magic to medicine has been largely overlooked, namely, the ancient Egyptian idea of weighing the heart after death.

To be sure, the Egyptians weighed the heart for eschatologic purposes rather than for prophecy or application to medical judgments. The ancient Egyptians were far more concerned with the afterlife than the transitory and ephemeral concerns of life on earth. Orientation of their thought toward the hereafter probably accounts for such latter day judgments as, "One might imagine that the widespread practice of embalming the dead body would have stimulated the study of human anatomy, but it was not the case."[1] Nonetheless, even as weighing the heart was an integral part of Egyptian religion, an essential element in the judgment of the dead, so at

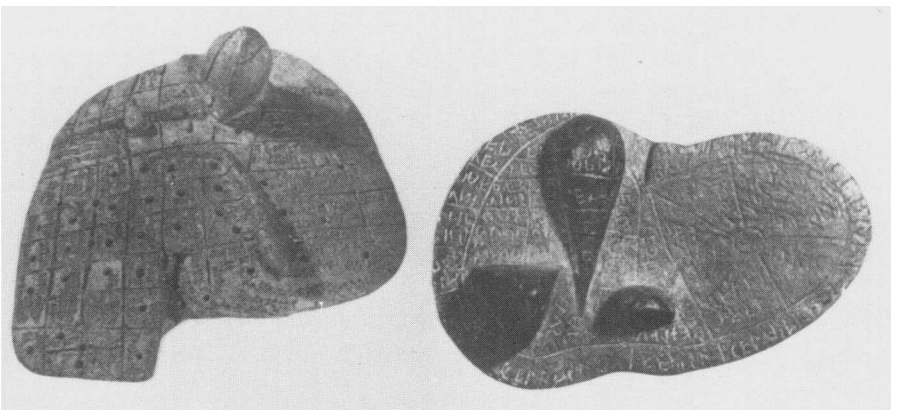

Fig. 1. Clay model of sheep's liver (left) used by Sumerians and Baylonians for divination, circa 1830-1530 B.C. Courtesy of the British Museum. Bronze model of sheep's liver (right) used by Etruscans for divination, circa 1000-800 B.C. Courtesy of the Piacenza Museum. It is conjectured that using the liver of a sacrificed animal for divination originated in Mesopotamia and was transmitted to Northern Italy. Putatively, haruspex is derived from the Chaldean *har*, meaning liver.

the autopsy table pathologists of today weigh the heart religiously and form judgments based upon that datum.

Egyptian religion was based on a solar monotheism appropriate for official and ceremonial purposes supplemented by a polytheistic pantheon of gods and goddesses of varying degrees of importance and influence. The latter ranged from an "executive cabinet" of major deities charged with specific departmental functions down to a host of regional or local deities to serve demotic needs. Such familiar names as Osiris, Isis, Horus, Amon, Set, Geb, Nut, Ptah, Maat, Thoth, and Anubis were important figures in the "cabinet" and were the prototypes of the Greek deities of Olympus. They were usually considered to be the children or grandchildren of the sun god, Re (Ra). The cult of Osiris was one of the most important, largely because Osiris was god of the Underworld.

Osiris began his career as a vegetation-fertility god, one of many such. He was killed in a quarrel with his brother Set, who cut his body into pieces and threw them into the Nile. After a long search his sister-wife Isis (cf. later Ptolemaic marriages between siblings) recovered the pieces except for the genitals which had been eaten by fish, sewed them together, and restored Osiris to life. The idea of a mutilated and resurrected god ought not seem strange to Christians. In *Areopagitica* Milton compared Isis's quest to the search for truth:

> Truth indeed came once into the world...then straight arose a wicked race of deceivers, who...dealt with Osiris, took the virgin Truth, hewed her lovely form into a thousand pieces, and scattered them to the four winds. From that time ever since, the sad friends of Truth, such as durst appear, imitating the careful march that Isis made for the mangled body of Osiris, went up and down gathering up limb by limb still as they could find them. We have not found them all, Lords and Commons, nor ever shall do so, till her Master's second coming [when] he shall bring together every joint and member, and shall mould them into an immortal feature of loveliness and perfection.[2]

One may also construe the metaphor as a statement of the scientific method, collecting the data and assembling them to form a faultless statement.

Because he had once died, Osiris was charged with supervision of the Underworld, and it was to his realm that the king and later the nobility and priesthood were translated. After a few generations had passed, it became the goal of every Egyptian to join Osiris and the blessed company of the honored dead in Paradise. For the ancient Egyptian, life after death was a real physical resurrection with sensory and motor functions restored. It was considered his duty to cultivate the domains of Osiris and keep the dykes and irrigation canals in good order; the kingdom of the dead was a replica of the Egyptian state. Food and utensils stored in tombs indicate their expectation of normal gastrointestinal function despite the fact that the stomach and entrails were removed prior to mummification and stored in canopic jars. That normal sexual function was anticipated in Paradise is indicated by a coffin text that reads in part, "For any man who shall know this spell, he shall copulate in this land by night and day, and desire shall come to the woman beneath him whenever he copulates."[3] Life in the Underworld was "business as usual," and, as befits most African religions, its gods and inhabitants were apperceived at a level of reality corresponding to Marc Connelly's *Green Pastures*.

The cult of Osiris survived for over two millenia and was one of the dominant themes in Egyptian faith. Much of our knowledge about its eschatology comes from the so-called *Book of the Dead* (lit. *The Book of Coming Forth by Day),* papyrus scrolls recovered from mummy wrappings containing a variety of texts, and an even more varied assortment of illustrative vignettes. The earliest versions of the *Book of the Dead* date from the 18th Dynasty (1567-1320 B.C.), and they continued to be written until the fourth century A.D. The text was not codified until the Ptolemaic period some time in the third century B.C. Until then the

scribes who prepared the scrolls used whatever texts were at hand and suited their customers. Some passages can be traced back to the Pyramid Texts, spells and incantations incised in the stone walls of burial chambers dating back to the fifth Dynasty under Wenis (Unas) circa 2360 B.C. At that time translation into the company of the gods was reserved for the king who was their descendant and enjoyed the prerogative by right of birth. One such text proclaims that the king was pure of heart. It may seem anomalous that magical spells should be used to ensure the king's safe passage into the afterlife; in theory he required no such assistance.

Over the next few centuries the privilege of joining Osiris and the king was extended to courtiers, the nobility, and the priesthood. Their bodies were mummified and buried in coffins, hence the development of Coffin Texts, elaborations from the incantations of the Pyramid Texts, written on the sides of the coffins. Needless to say, mummification, an expensive and time-consuming process, was beyond the reach of commoners. The bodies of the ordinary Egyptian and his family were consigned unceremoniously to the desert sands where they decomposed anonymously even as do the bodies of their descendants today.

What elevates the *Book of the Dead* above the level of primitive magic is its incorporation of a moral code and the idea of a judgment of the dead. These are embodied in the famous chapter 125 as the so-called Negative Confession and the rich iconography of the judgment scene in which the heart is weighed against the feather of truth. A contemporary example of the use of a scroll containing a religious text as protection against an evil fate can be seen in the *mezzuzah* that Jews fasten to their gateposts.

After the *ba* (or soul) of the deceased had entered the underworld, it was led into the Hall of Maat, the goddess of truth, justice, and cosmic order, whose symbol was a feather. The hall is sometimes referred to as the Hall of Two Truths, perhaps because a statue of Maat was placed at either end. Seated in the hall were the 42 assessors (or judges), their number corresponding to the number of nomes (administrative districts) of ancient Egypt. It was to this panel that the deceased recited the Negative Confession, not truly a confession of sins in the modern sense but rather a blanket denial of wrongdoing supplemented by claims of virtue, charity, and purity of heart. The confession consists of 42 separate declarations, one addressed to each assessor, and there are considerable duplications among the postulations of innocence. The scribes were rather unimaginative at constructing a litany of evil. The deceased denied having committed murder,

acts of violence, a variety of forms of theft and fraud, perjury, blasphemy, sexual misconduct, as well as offenses specific for an agrarian society, viz., "I have not laid waste the lands which have been ploughed"; "I have not made light the bushel," i.e., given short weight; and "I have not fouled running water," nor presumably the footpath. The sins denied seem to include most of those listed in the Ten Commandments and some of the forms of misconduct proscribed in *Leviticus*. The only significant item added in the Decalogue is the matter of graven images, a prohibition that may explain why Judaism was noted for its exegetical textual criticism but impoverished in representational fine arts such as painting and sculpture. It is notable that in Judaica the "arts" largely feature such decorative *Kleinkunst* as elaborate finials for Torah scrolls and fancy spice boxes. Not until the 20th century was there a Jewish painter or sculptor of first rank. A communal form of confession, albeit in a positive sense, is found in the Yom Kippur service, when Jews assembled for prayer ask forgiveness for a comparable catalogue of sins, but this liturgy dates from Rabbinic times.

The exodus of the Israelites from Egypt is said to have taken place during the 19th Dynasty, circa 1280 B.C., in the reign of Rameses II, known as the Pharaoh of the Oppression. Like other newly developed religions, Judaism combined both innovation and imitation. With their happy faculty for oversimplification, the Israelites adopted monotheism as their innovation and buttressed it with the catchy slogan, *adonai echod.* Their imitation, the continuation of tradition, was the moral element found in the Negative Confession. What we so proudly hail as Mosaic Law and Judaeo-Christian ethics seems to be a transcription, redaction, and recension of an idealized code of conduct for Nilotic noblemen. Perhaps Shelley underestimated the influence of Ozymandias.

Once the deceased had enunciated the Negative Confession and proclaimed his acts of charity he was ready to have his heart weighed. This was feasible because in the embalming process preceding mummification, ". . .the heart was purposely left *in situ,* to allow the future survival of the deceased. If by accident it was detached, it was imperative to replace it inside the body, either free or attached by a ligature."[4] Parenthetically, the kidneys were also left behind, probably because their retroperitoneal location made access difficult and it was not essential that they be bathed in embalming fluid. There is no hieroglyph for the kidneys; they were unknown to Egyptian vocabulary. One recalls that prior to Richard Bright's study of renal disease in the first half of the 19th century the kidneys were not routinely examined at autopsy.

Scrolls of the *Book of the Dead* often depict this weighing of the heart, and additional representations are found as wall paintings in tombs, on mummy cases, and on the cerements used to shroud the cadaver. Seeber's comprehensive monograph[5] classifies these vignettes with respect to period, location, content, and other features. Considerable iconographic variation is evident. The artist was allowed considerable latitude in selecting and composing the representation, provided the essential elements were shown. Comparable tensions between freedom and restraint confronted Renaissance artists commissioned to paint such scenes of Christian symbolism as the many annunciations, nativities, crucifixions, and resurrections that adorn books of hours, missals, chapels, altars, and latterly museum walls.

The central element was the beam balance with the heart placed in one pan and balanced against Maat in the other. Maat was often represented symbolically by her hieroglyph, the feather, but sometimes a statuette of the goddess wearing her feather was used. The actual weighing was conducted by the jackal-headed Anubis; sometimes he was assisted by the falcon-headed Horus, and in a few examples Horus alone conducted the weighing. The result was recorded by the ibis-headed Thoth, chief secretary to the Egyptian pantheon, and, in many representations, Thoth's cynomologus monkey sits on top of the center post, probably to indicate how scrupulously the scales of justice were watched. If the deceased's heart were pure and balanced evenly with Maat or the feather of Truth, he was considered "justified," and after a few ceremonial allocutions was admitted to the company of Osiris and the blessed. If not, if his heart was heavy and laden with sin, it was cast to the devouring beast Ammit, depicted as a chimera with the head and jaws of a crocodile, the body of a lion, and the rump and tail of a hippopotamus. The idea is echoed in the handwriting on the wall at Belshazzar's feast (c. 540 B.C.) in which *TEKEL* is translated as, "Thou has been weighed in the balances and found wanting."

Portrayals of the judgment scene vary widely in complexity and detail. Most familiar is the frequently reproduced panel from the 19th Dynasty papyrus of Ani (c. 1250 B.C.), which displays all the elements cited above. By contrast, the 21st Dynasty papyrus of Queen Nedjemt (c. 1000 B.C.) merely exhibits a balance, with her heart balancing a statuette of Maat and no god present to conduct the weighing or record the result. Almost as simplified is the 18th Dynasty wall painting from the tomb of the Noble Menna (c. 1412 B.C.) showing Horus rather than Anubis

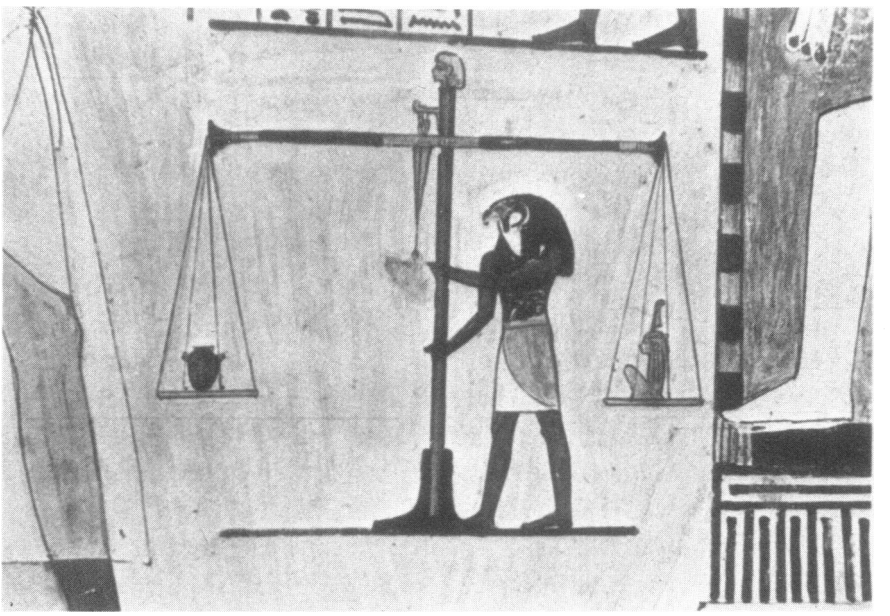

Fig. 2. Horus weighing the heart against a statuette of Maat. Wall painting from the tomb of the Noble Menna at Thebes, (c. 1412 B. C.), 18th Dynasty.

weighing the heart against Maat (Figure 2). More detailed, including the hieroglyphic text of an appropriate prayer, is the 21st Dynasty papyrus of Princess Entiu-ny (c. 1025 B.C.) in which Anubis controls the balance, although Thoth is not shown as recording (Figure 3). In this papyrus an offering of food is placed before the seated figure of Osiris, the haunch of an ungulate, perhaps a lamb or a goat. This was the choicest cut of flesh, and perhaps the Talmudic interdiction against eating the hind quarters of even those animals that chew the cud can be traced to a rejection of what was thought fit for an Egyptian god. In such Ramesside papyri as those of Nesi-pa-ku-shuty and Ta-udja-re the food offerings are more sumptuous; included are a heart and lung, cuts of rib, loaves of bread, onions, leeks, and assorted vegetables, a basket of fruit, even lotus flowers, clearly a more balanced diet. One of the simplest representations is the monochrome line drawing resembling a draftsman's outline in the 21st Dynasty papyrus of Nestanebtashru (c. 1000 B.C.), wherein Osiris closely supervises the scene in which Anubis weighs, his hand on the plummet, Thoth stands

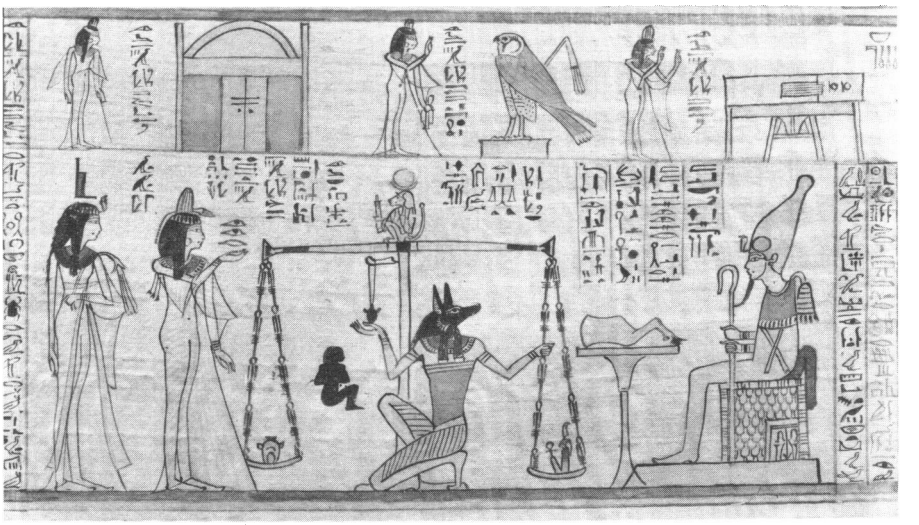

Fig. 3. Judgment scene from the funerary papyrus of the Princess Entiuny, daughter of King Pay-nudjem. From the tomb of Queen Meryet-Amun at Deir el Bahri, Thebes (c. 1025 B. C.). Courtesy of the Metropolitan Museum of Art.

ready to record, and Ammit looks hungry, anxious to receive and eat the heart if it proves unjustified (Figure 4).

As in any other survey of the iconography of a set religious subject, one can find individual details of interest. The 20th Dynasty papyrus of Anhai (c. 1150 B.C.) shows her just after justification, her body liberally decorated with the feathers of Truth, resembling that of St. Sebastian pierced by arrows. The 21st Dynasty papyrus of Tameniu (c. 1000 B.C.) exhibits a curious juxtaposition. Just to the left of a conventional judgment scene and without intervening explanatory text is a vignette of the creation myth, the sky goddess Nut being torn from an ithyphallic earth-god Geb, who seems to be falling through space. The colorful Ptolemaic papyrus of Ker'asher (first century B.C.), a relatively late example, shows both Horus and Anubis weighing the heart beneath a frieze of the 42 assessors. Earlier papyri showed fewer witnesses, sometimes a representation of the Theban Enniad, sometimes a miscellany of major and minor deities. A prominent feature of the judgment scenes, well displayed in the papyrus of Entiuny (Figure 3) occupying the space between Anubis's right hand and the pan with the Princess's heart, is the dark figure of the birth child symbolizing resurrection.

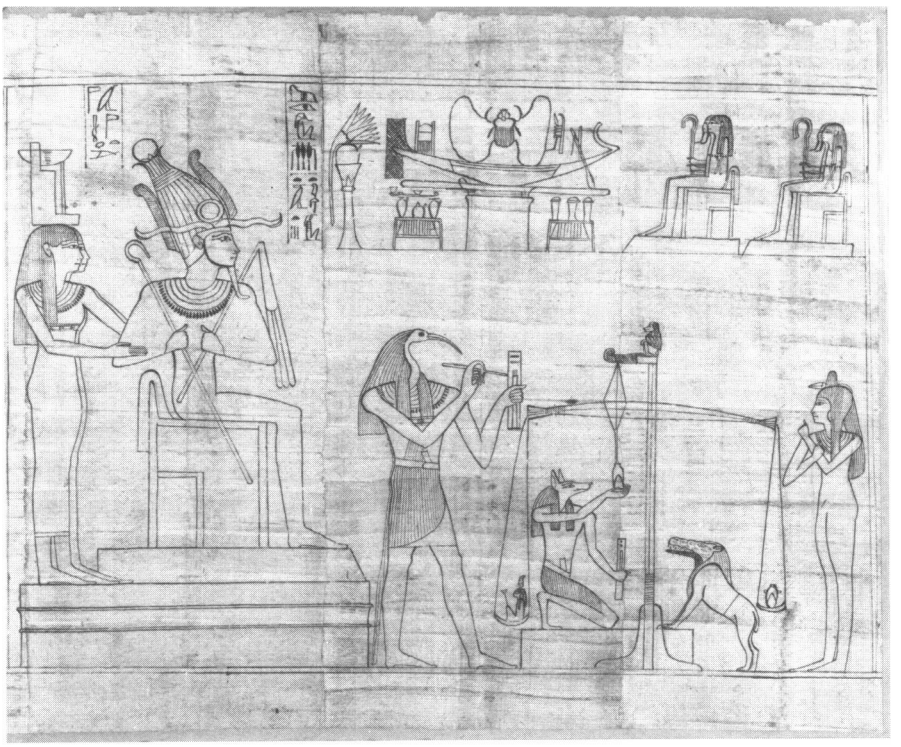

Fig. 4. Judgment scene from the Papyrus of Nestanebtashru. Thebes (c. 1000 B.C.), 21st Dynasty. Courtesy of the Trustees of the British Museum.

Relics to indicate that weighing was an important aspect of life in the classical world are rarely encountered outside the Egyptian judgment scene. The Archaelogical Museum at Athens has a set of gold scales recovered by Schliemann from a child's grave at Mycenae. The precious metal and their small size suggest that they served no practical purpose, nor can a correlative be found for them in any Greek religious idea. A marble sculpture in the Museum of Fine Arts at Boston shows two women with an Eros poised between them. Though parts of the sculpture, notably the scales, are missing, the presence of weights at the base and the disposition of the figures suggest a weighing scene. One of the women wears a happy expression, the other a sad one; perhaps it represents the result of a beauty contest. But the provenance and purpose of the group

Fig. 5. St. Michael weighing a soul in a balance. From a tympanum at Bourges, (c. 1280-1290).

remain debatable. In Egypt, Coptic Christianity gradually replaced the old Egyptian gods. That the transition was gradual, even peaceful, can best be seen in the second century Kom al-Shugafa catacombs at Alexandria where Egyptian and Christian iconography are inextricably intermixed. By the fifth century only the faintest traces of Egyptian religion remained, and there are no examples of the *Book of the Dead* after this period.

The idea of a Last Judgment is, of course, explicit in the Revelation of St. John the Divine, but Christianity emphasizes the spiritual rather than the somatic aspect of resurrection. Exegesis of the parable of the valley of dry bones in Ezekiel, chapter 37, includes the notion of physical resurrection, but it is not generally taken as doctrinal. In the 1950s a painting by Sir Stanley Spencer of his friends and neighbors climbing awkwardly out of their coffins in the local churchyard at Cookham created some dismay, most of which centered around the feeling that Judgment Day couldn't be

Fig. 6. Detail from the Doomsday mosaic in the Cathedral at Torcello showing an angel with an empty balance (13th century).

quite like that. The early Middle Ages provide no iconography of a soul actually being weighed and judged. But given the exigencies of artistic representation, it is not surprising that after a few centuries scenes depicting physical resurrection began to appear in painting, sculpture, and mosaics. In large measure the fine arts of the era existed to supply visual reification of spiritual ideas; the word was made flesh, or at least so depicted, cf. "I shall see my Maker face to face."

By tradition the Archangel Michael was given the role of psychopomp. The precise origin of this tradition remains obscure, but Boase[6] cites and illustrates a 13th century Catalan altar frontal in which St. Michael is shown weighing a naked and supplicant soul in a balance, and a relief from a tympanum at Bourges (C. 1280-1290) adds the detail of a devil trying to tilt the balance in his favor (Figure 5). A similar group is found in a Last Judgment relief over the central portal of the west facade of Notre Dame at Paris. Even more striking is a detail from a mosaic of Doomsday in the

13th century basilica at Torcello, in which a gracefully floating angel carries an empty balance (Figure 6). The subject was popular with Spanish painters of the 14th and 15th centuries as well as with their Sienese, Florentine, and central Italian contemporaries. One panel in a portion of polyptych by Simone Martini, now at the Fitzwilliam Museum, shows St. Michael holding a balance. Perhaps the most frequent treatment shows him in armor with a sword in his right hand, sometimes using it to kill a dragon, and the balance in his left hand or attached to his belt. Depending on the artist's taste, the balance may be empty or contain a soul about to be weighed.

A finely executed panel by the late 15th century Florentine Domenico Ghirlandaio, now in the Portland (Oregon) Art Museum, shows St. Michael in armor with his sword in one hand and the scales of justice in the other. Such other 15th century Italian masters as Signorelli and Moroni used the same symbols. A particularly felicitous painting by a pupil of Leonardo titled "La Vierge aux Balances," now at the Louvre, dated c. 1510, shows the Madonna and Child with St. Anne and the infant St. John; at their left is an ephebic, epicene St. Michael playing with the balance and the Christ child (Figure 7). The museum at Le Bar-sur-Loup in Provence has an anonymous 15th century wood panel with a *danse macabre* occupying the upper portion. The Archangel Michael is shown with scales at the left of a circle of sinners dancing to their perdition; beneath is a hortatory and monitory text intended to remind the beholder of his certain fate should he die uncontrite and unshriven. Many legends have accumulated around St. Michael's role as an intercessor, but representations of him with the balance for weighing souls seem to disappear after the middle of the 16th century. Like the other archangels, angels, and saints, he had many duties to perform; to these Pius XII added in 1950 his role as patron saint of policemen.

In the Middle Ages the heart itself was not weighed, but on occasion it was accorded special treatment. Robert Bruce's heart was placed in a silver casket and despatched by messenger for burial in the Holy Land. Other instances of separate interment of the heart are recorded. During these centuries postmortem dissection and embalming were carried out much less frequently than in Egypt. As in Egypt, it was reserved for royalty and a few members of the nobility and ecclesiastical hierarchy, usually to refute a suspicion of death by poisoning, though given the state of gross anatomic knowledge at the time, it is difficult to excogitate what

Fig. 7. La Vierge aux Balances, by a pupil of Leonardo de Vinci (c. 1510). Photo Alinari.

Fig. 8. Detail of the tomb effigies of Louis XII and his queen from the abbey church of St. Denis (c. 1515) showing the incisions and sutures after evisceration and embalming.

anatomic experience might have served as a basis for a confident judgment. The effigies of Louis XII and his wife, Anne of Brittany, (c. 1515) on the tomb in the abbey church of St. Denis recall evisceration and the embalming procedure to visual memory (Figure 8). On a happier occasion, that of their marriage, it was for these two monarchs that the celebrated and festive unicorn tapestries were woven. But, with only sporadic exceptions, the idea of weighing the heart for either religious or medical purposes was unimportant in Western Europe until the 17th and 18th centuries.

Weighing the heart for medical purposes is a post-Harveian idea, motivated by the need to estimate cardiac volume. The first record of this form of weighing is the observation by Theodore Kerkring[7] in 1670 who stated that the heart weighed seven ounces. Eighteenth century anatomists added the idea of linear measurements, viz., the circumference of cardiac valves, thickness of ventricular walls, and other measures of length and breadth.

Yet Morgagni, who described so many examples of cardiac disease so well, never recorded the actual weight of the organ. Elaborating the clinicopathological concepts of Bichat, Laennec, and Corvisart, French anatomists and pathologists began to weigh hearts. Bouillaud,[8] for example, gave the average weight of the heart as 8 oz., 3 gr., but his observations, as well as previous ones by Senac and Cruveilhier, did not distinguish between male and female hearts, nor did they take into account the effects of age. Developing the concept of cardiac hypertrophy, Cruveilhier[9] stated that weight was preferable to linear measurements to resolve the point, but it was a statement of principle rather than the result of systematic observations.

Lobstein[10] contributed a few observations on heart weight, but it remained for Clendinning[11] to publish the first tabulation of the weight of the heart and other organs taking age and sex into account; these and the tabulations by Reid[12] and Peacock[13] are the basis for our modern ideas of heart weight. But the idea of weighing the heart at the autopsy table was slow to take root. Rokitansky[14] seems to have confined his observations to linear measurements, and Virchow's manual of postmortem technique,[15] written as late as 1875, does not instruct prosectors to weigh the heart or any other organ. Yet only a few years later, in 1883, Müller[16] published his monograph dealing in a highly sophisticated fashion with partitioning the heart and weighing its anatomical subdivisions.

The feather of truth has changed its colors as the paramount values of society have shifted. From the moral code of the ancient Egyptians through the spiritual values of medieval Christianity we have arrived at a modern society that prizes quantifiable information as its *summum bonum*. Today's youth is more familiar with baseball statistics than its catechism, and adults are more likely to have stock-market quotations and the cost of automobiles and their miles per gallon of gasoline at ready recall than to be able to quote chapter and verse of scripture. Homage to numbers permeates all walks of life, from Professor Max Gottlieb's commitment to the quantitative method in Sinclair Lewis's *Arrowsmith* to the fact that the simplest demotic game of chance, one requiring almost no cerebration or active participation by its players, is known as "the numbers game." For pathologists, the descendants of the jackal-headed Anubis, automated laboratory equipment churns out a daily quota of computerized printouts, and certainly the medical segment of today's society seems obsessed with numbers. It should be noted that it took longer for quantitative data to be

applied to biological and medical problems than to other disciplines. Early in the history of science astronomers made quite accurate measurements of sidereal phenomena, and for cogent commercial reasons measurements of land were precise. Without denying the usefulness of replicable and verifiable empirical data as one of the bases upon which science rests, there is more to science and medicine than coefficients of variance and standard deviation curves. Perhaps we ought to consider carefully Thomas Huxley's caution that although all science is measurement, not all measurement is science. But we shall continue to weigh the heart for whatever small insight it may provide into the barbs and barbules that form the body of the feather of truth.

REFERENCES

1. Guthrie, D.: History of medicine. *Encyc. Brit. 15:*94, 1966.
2. Milton, J.: Areopagitica. In: *Milton's Prose*. London, Oxford University Press, 1925, p. 311.
3. Faulkner, R. O.: *The Ancient Egyptian Coffin Texts*. Warminster, Aris & Phillips, 1977, vol. II, p. 181.
4. Ghalioungui, P.: *Magic and Medical Science in Ancient Egypt*. London, Hodder & Stoughton, 1963, p. 159.
5. Seeber, C.: *Untersuchungen zur Darstellung des Totengerichts in Alten Ägypten. Münchner Ägyptologische Studien, Heft 35*. Munich, Deutscher Kunstverlag, 1976.
6. Boase, T. S. R.: *Death in the Middle Ages: Mortality, Judgment and Remembrance*. London, Thames & Hudson, 1972, pp. 34-35.
7. Kerkring, T.: *Spicilegium Anatomicum continens Observationum Anatomicum Rarorum. &c.* Amsterdam, Frisii, 1670, p. 39.
8. Bouillaud, J.: *Traité clinique des maladies du coeur*. Paris, Ballière, 1835, pp. 25-72.
9. Cruveilhier, J.: *Essai sur l'anatomie pathologique en général, et sur les transformations et productions organiques en particulier*. Paris, l'Auteur, 1816, vol. I, pp. 184-85.
10. Lobstein, J.: *Lehrbuch der pathologischen Anatomie*. Stuttgart, Broadhag, 1835, vol. 2, pp. 350-62.
11. Clendinning, J.: Facts and inferences relative to the condition of the vital organs and viscera in general, as to their nutrition in certain chronic diseases. *Med.-Chir. Trans. 21:*33-68, 1838.
12. Reid, J.: On the measurements of the heart. *Monthly J. Med. Sci. 3:*295-323, 411-12, 1843.
13. Peacock, T. B.: On the weight and dimensions of the human heart in health and disease. *Monthly J. Med. Sci. 19:*193-214, 313-23, 403-27, 1854.
14. Rokitansky, C.: *A Manual of Pathological Anatomy*. London, Sydenham Soc., 1853, vol. 4, pp. 150-71.
15. Virchow, R.: *Die Sektions-Technik im Leichenhause*. Berlin, Hirschwald, 1875.
16. Müller, W.: *Die Massenverhältnisse des menschlichen Herzens*. Hamburg and Leipzig, Voss, 1883.